



Readall* Readout Instruments

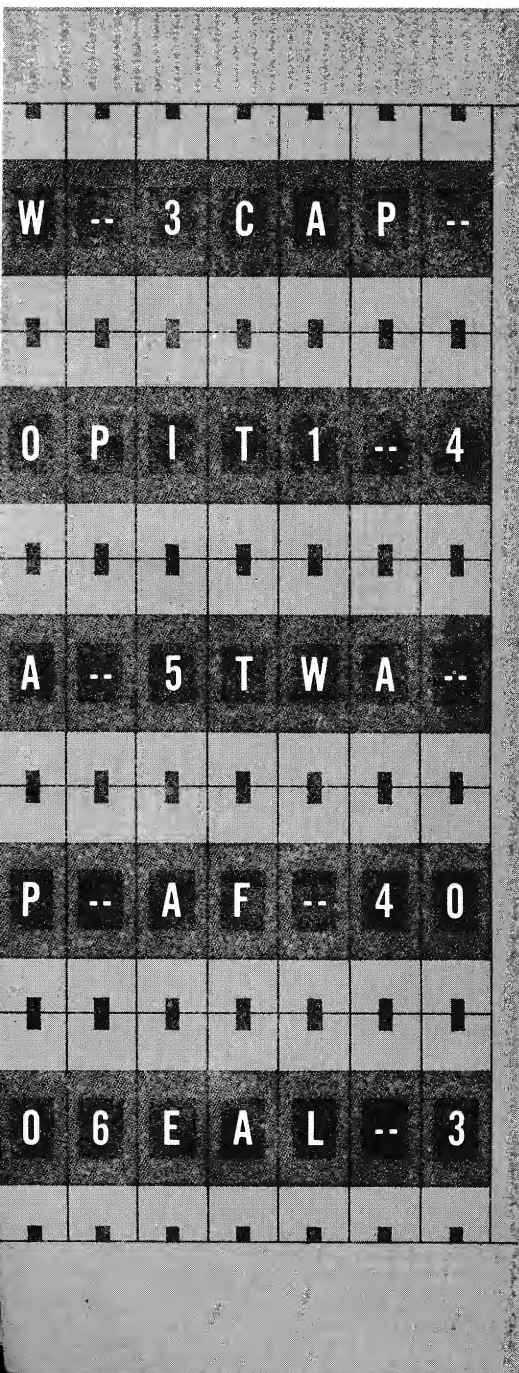


UNION SWITCH & SIGNAL DIVISION

Westinghouse Air Brake Company
PITTSBURGH, PA. 15218

* TRADE MARK

BULLETIN NO. 1057-A



READALL* Readout Instruments are precision-built devices for handling data and for displaying characters in accordance with a pre-determined code. READALL Readout Instruments will translate, display, store, retain and transfer data in digital form. The instruments are compact and self-contained and can be applied to the output of telemetering systems, digital computers, teletype receiving equipment, or wherever data must be displayed.

The operation of READALL Readout Instruments is based on a positioning system utilizing a binary code. The visual display is the result of a direct electro-mechanical conversion of a binary signal to a digital readout. Use of this digital display system in commercial, industrial and military applications makes it possible to eliminate additional complicated code conversion equipment and "black boxes" ordinarily required for use with more indirect readout methods, such as lamp or tube type displays.

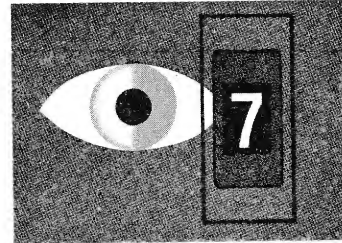
Functional parts of READALL Readout Instruments are assembled in compact modules which can be used individually in separate cases, or in groups to display multiple characters in a single case. They are designed for plug-in mounting so that data or messages of any desired length can be stored, displayed, or transmitted at will. The rugged, miniaturized construction of these readout instruments enhances applications in ground, airborne, shipboard or mobile systems.

An outstanding feature of READALL Readout Instruments is found in their ability to retain information indefinitely. They are so constructed that they store the positioned character electrically as well as visually. The stored code can be transmitted into other readout instruments, printers or transmitters. Once positioned, they consume no power while information is retained and displayed.

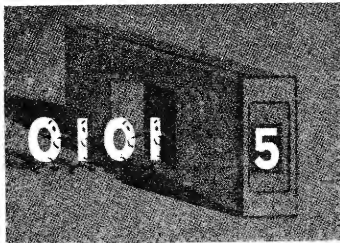
Outstanding Features in One Small Package

1 READABILITY OF DISPLAY

Characters are easily discerned and are extremely legible, even under many abnormal viewing conditions. Adequate and effective illumination techniques are employed in several of these instruments to meet specific environmental conditions. Human factors involved in determining visual acuity under many conditions of operation have been considered in the design of these readout instruments. These include:

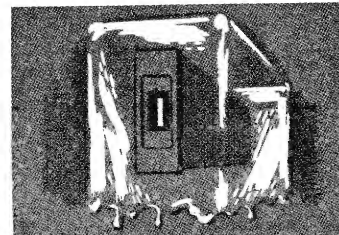


- shape, size and style of characters
- color and brilliance of illumination
- angles of visibility
- spacing of adjacent characters in an array
- presentation of characters in one plane



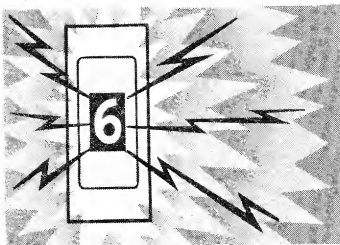
2 BINARY DECODING

READALL Readout Instruments decode four- or six-bit binary codes electro-mechanically and display a character equivalent to the input on a wheel or belt. Operation is based on an agreement-seeking principle.



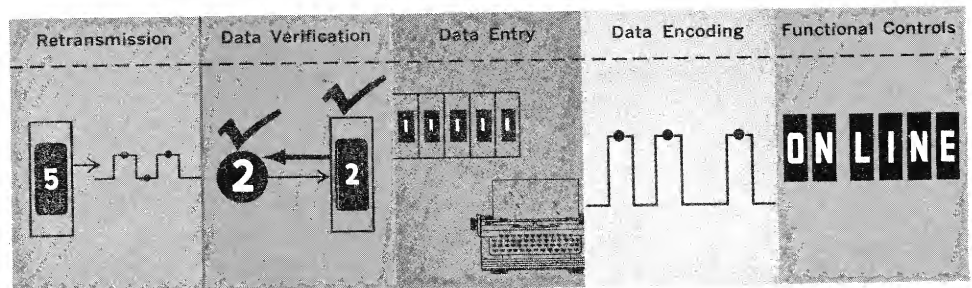
3 DATA STORAGE

Simultaneously, the displayed information is stored in binary form for future use. Information is retained indefinitely, visually and electrically, until a new code is transmitted. Continued power input is not required to maintain display, or storage.



4 ELECTRICAL READOUT

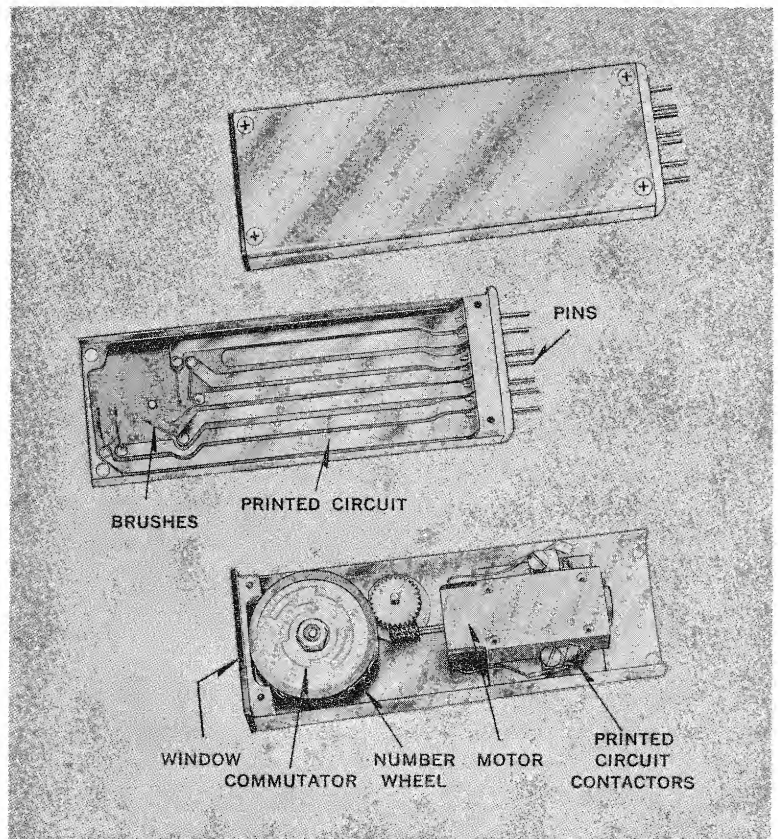
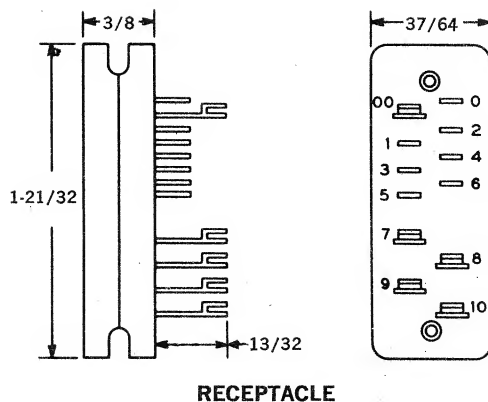
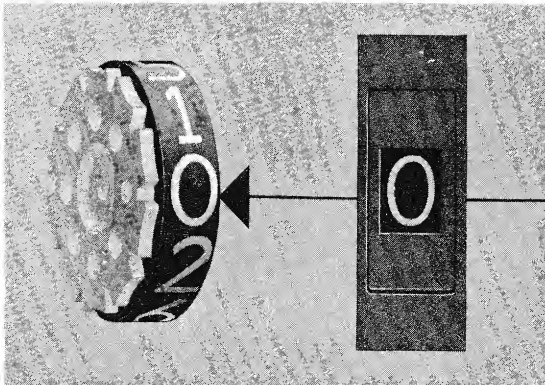
Since the displayed data is stored in binary form, the READALL Instruments provide electrical readout for



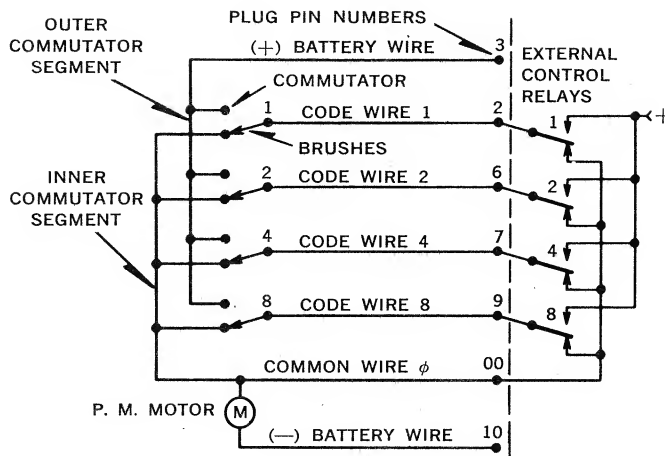
10-Character READALL Readout Instruments will operate through one million random operations reliably and efficiently. This readout instrument has set the high standards which resulted in the development and construction of its companion products. Maintenance problems are practically nonexistent. These readout instruments utilize a four-bit binary code to position ten characters for visual display. The relation of the visible character to its code is the direct translation of binary notation to decimal indication. If desired, combinations other than those included in this particular instrument can be developed.

A single code disc is used in the READALL Readout Instrument. A total of six brushes are used, four of which make selective contact in combination to the plus battery segment or the motor circuit segment. Once a character is positioned for readout, it is retained indefinitely, visually and electrically, until a new code is transmitted to the instrument.

10-CHARACTER



CIRCUIT DIAGRAM



CODE TABLE	
CHARACTER	CODE 8-4-2-1
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

Readall Readout Instrument

SPECIFICATIONS

Character Size

Height	3/8 Inch
Width	1/4 Inch
Character Stroke Width	.040 Inch

Nominal Operating Data at 60°-80° F

Voltage	24 to 28 Volts
Motor Starting Current at 26 VDC	0.500 Ampere
Motor Running Current at 26 VDC	0.125 Ampere
Power, Running	3 Watts, Average
Power, Steady State	0.0 Watts
Running Time (9 character spaces)	0.8 Second
Life	10 ⁶ Random Indications

Dimensions, Over-all

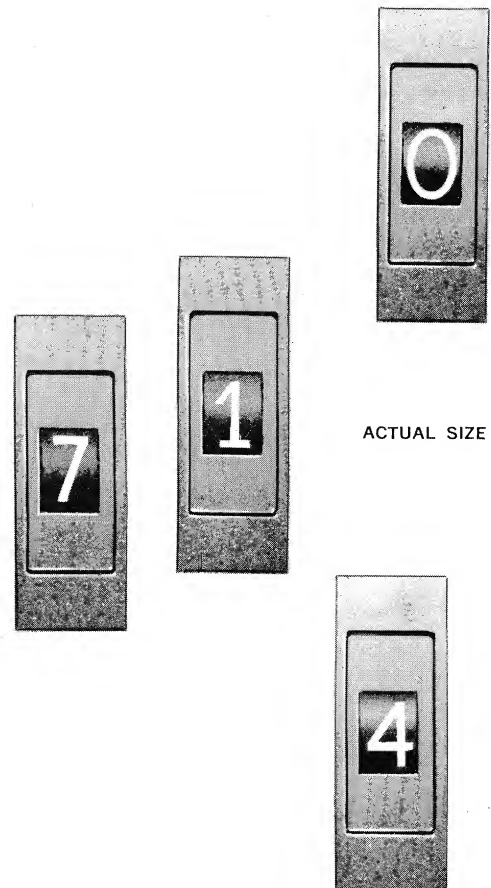
Length (including pins)	5-5/64 Inches
Height	1-41/64 Inches
Width	19/32 Inches

Instrument Weight less than 7 ounces

ORDERING REFERENCES

Readall Readout Instrument

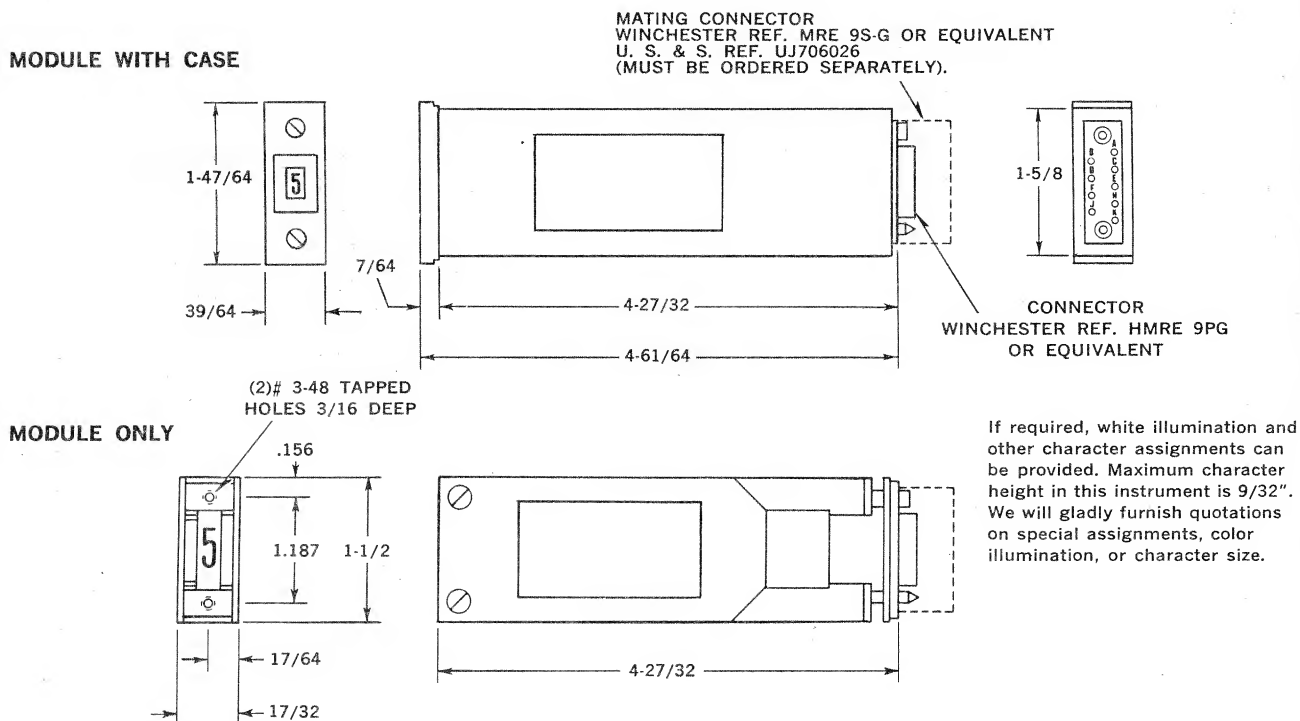
Characters 0-9 inclusive	UN341783
Mating Receptacle (order separately)	UN310097

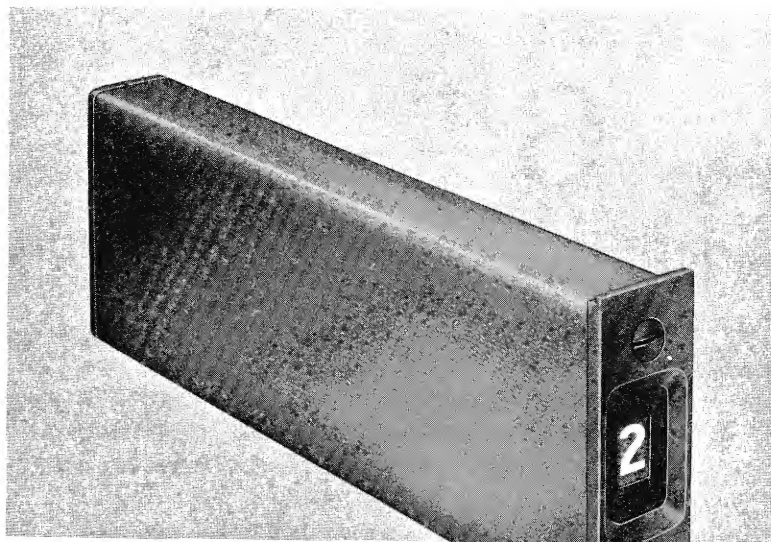


The 12-Character READALL Readout Instrument is a precision-built instrument designed to meet the severe environmental requirements specified in MIL-E-5422D and other specifications. It provides operation under conditions of shock, vibration and extreme ranges of temperature. The digital display includes characters in numerical sequence from 0 to 9 and two blank spaces for additional significant symbols. This readout instrument is provided with internal back-lighting. The characters may be illuminated in red or white, as desired. During daylight operation, characters will appear white on a black background. Two miniature lamps are utilized to assure continued readability in the event one lamp fails.

These readout instruments can be used individually in separate gasket-sealed cases, or as modules assembled in groups to display several characters in a single case. Greater flexibility of operation is provided through the separate code and motor circuits, which permit application in low level circuitry.

12 CHARACTER Readall Readout Instrument





SPECIFICATIONS

Character Size

Height	7/32 Inch
Width	1/8 Inch
Character Stroke Width	.030 Inch

Nominal Operating Data at 60°-80° F

Voltage	24 to 28 Volts DC
Motor Starting Current at 26 VDC	0.500 Ampere
Motor Running Current at 26 VDC	0.150 Ampere
Power, Running	3.9 Watts, Average
Power, Steady State	0.0 Watts
Running Time (11 Character spaces)	1.0 Second
Life	10 ⁶ Random Indications

Dimensions, Over-all

Length (excluding pins)	4-61/64 Inches
Height	1-47/64 Inches
Width	39/64 Inches

Instrument Weight with individual sealed case	7 ounces
without case	4-1/2 ounces

ENVIRONMENTAL DATA

Operating Temperature -54° C. to +71° C.

Storage Temperature -62° C. to +95° C.

Case: Gasket-sealed protection from salt spray, humidity up to 100%, sand, dust and fungus growth.

Impact shocks of 20 G's.

Altitudes up to 70,000 ft.

Vibrations from 5 to 500 cps at 10 G's.

Life: one million random operations

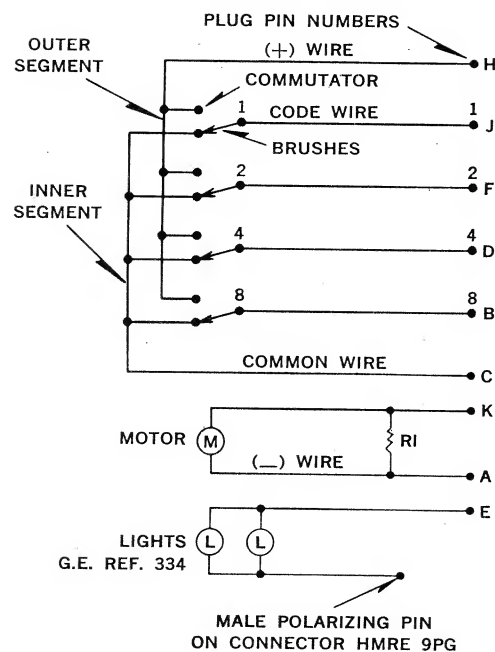
READALL Readout Instrument

Characters 0-9 and two blanks

Red illumination, with case UN375329-009

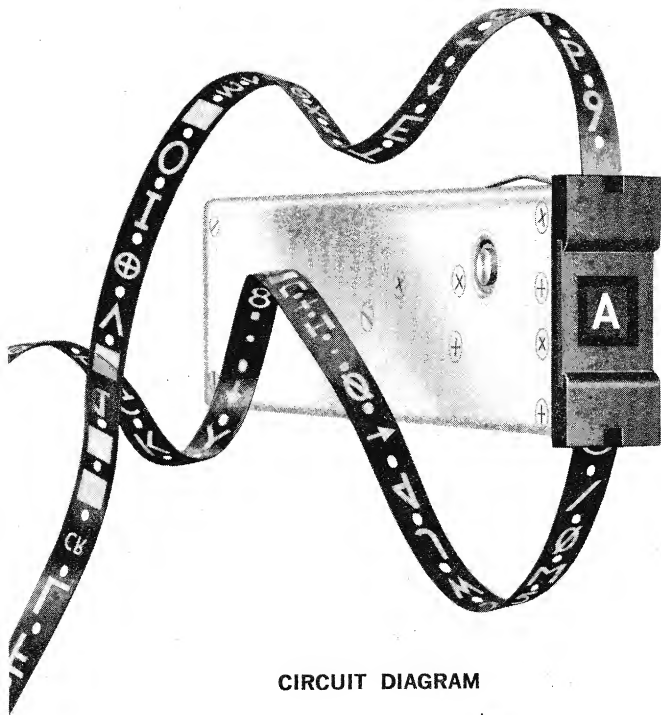
Mating Receptacles (order separately) { Mill standard MS24007
or U. S. & S. reference UJ706026

CIRCUIT DIAGRAM



CODE TABLE

ORDER REF. CODE 8-4-2-1	UN375329 -009 CHAR. ASSIGN.	UN375329 -049 CHAR. ASSIGN.
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	Blank	Blank
1011	Blank	Blank
Illuminated Color	Red	White
Character Height	7/32"	9/32"



64-CHARACTER Readall Readout Instrument

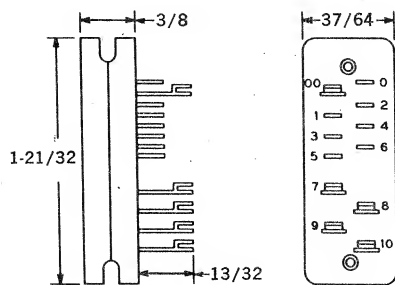
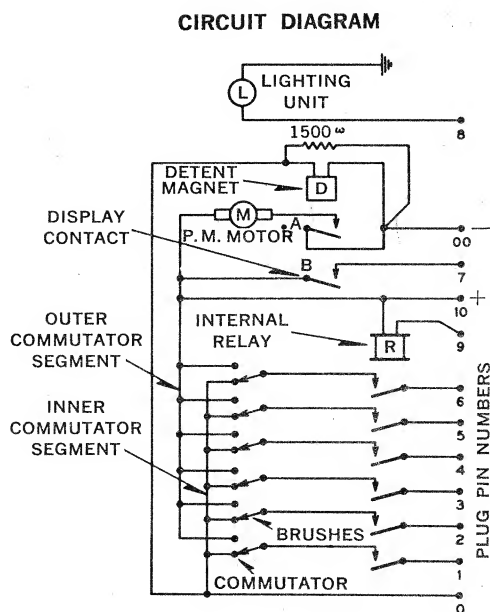
The 64-Character READALL Readout Instrument employs a six-bit code and a differential sprocket and belt arrangement to accomplish a digital readout. A belt containing 72 displayed characters is supported by two sprockets, eight and nine units in circumference. There is a distinct belt position for each combination of sprocket arrangements and there are 72 combinations.

Commutators mounted within the two sprockets are arranged so that signal brushes make contact selectively with the battery or the detent magnet. Each commutator has light codes, and one code is repeated on the nine-unit wheel. Therefore, the number of different codes is $8 \times 9 - 8 = 64$, which is the maximum number of characters capable of being read out by using a six-wire system. Eight of the characters appear twice on the belt.

A detent magnet, when energized, withdraws a pawl from the detent-wheel and closes a telltale circuit which may be used to determine whether a READALL Readout Instrument is running. An internal relay is provided to switch the six code wires so that strap-wiring techniques can be used when the instruments are arranged in rows or columns.

This 64-Character readout instrument is back-lighted with diffused light by means of a miniature aircraft-type bulb operated at half its normal voltage to lengthen the life span. In order to make back-lighting possible, the belt is made with characters on one side only. And, in order to reduce its size, the belt is formed into a Mobius-like configuration.

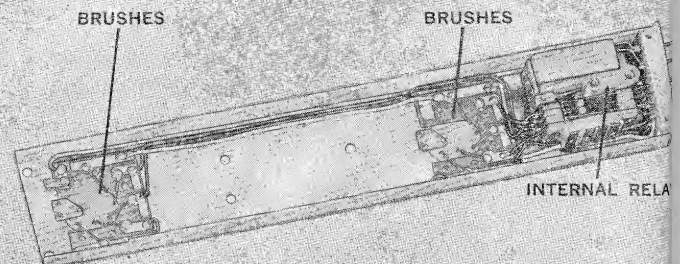
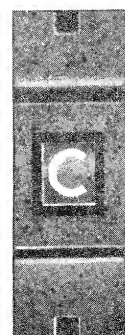
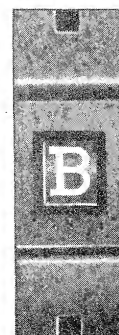
These instruments meet many of the requirements of the existing military specifications. Specific information can be obtained upon request.



RECEPTACLE



ACTUAL SIZE



SPECIFICATIONS

Character Size (letter M)

Height	9/32 Inch
Width	13/64 Inch
Character Stroke Width	.032 Inch

Nominal Operating Data at 60°-80° F

Voltage	24-28 Volts DC
Motor Starting Current at 26 VDC	0.60 Ampere
Motor Running Current at 26 VDC	0.150 Ampere
Power, Running Total	7.5 Watts
Power, Steady State	0.0 Watts
Running Time, (71 belt spaces)	1.7 Seconds
Life, Average	5 x 10 ⁵ Random Indications
Detent Magnet Resistance	175 Ohms
Detent Magnet Current at 26 VDC	0.15 Ampere
Detent Magnet, Average Operate Time	8 Milliseconds
Detent Magnet, Average Release Time	6 Milliseconds
Internal Relay Resistance	750 Ohms
Internal Relay Current at 26 VDC	0.035 Ampere
Internal Relay, Average Operate Time	11 Milliseconds
Internal Relay, Average Release Time	8 Milliseconds
Lamp Voltage, Suggested	6-8 Volts
Lamp Current, Average at 7 Volts	.056 Ampere
Lamp Power, Average at 7 Volts	.4 Watts
Lamp Life, rated at 12-14 Volts	500 Hours
Lamp Life, 6-8 Volts applied	Over 10 ⁴ Hours

Dimensions, Over-all

Length, including pins	10-25/32 Inches
Height, front face	1-47/64 Inches
Width, front face	39/64 Inch

Dimensions, Case

Height	1-41/64 Inches
Width	9/16 Inch

Mounting Centers (suggested)

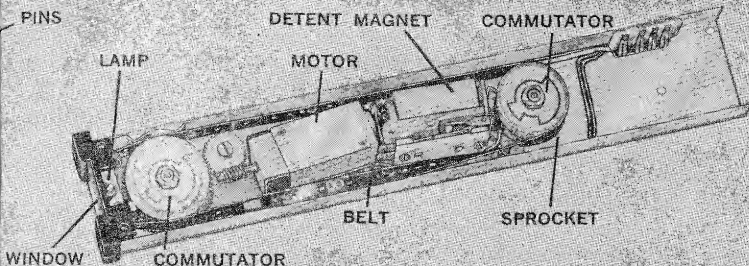
Vertical	1-3/4 Inches
Horizontal	5/8 Inch

Instrument Weight Less than 16 ounces

ORDERING REFERENCES

READALL Readout Instruments (see table)

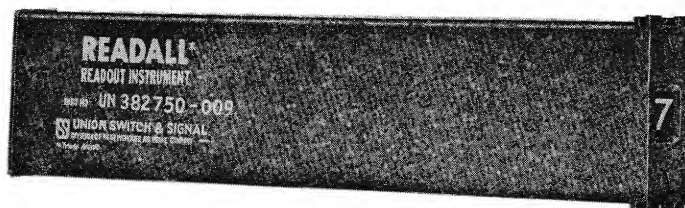
Mating Receptacle (order separately) UN310097



ORDERING REFERENCES FOR STANDARD INSTRUMENTS

Belt Position	Code 1-2-4-8-16-32	Readout Instrument UN366299 Character Assignment	Readout Instrument UN377108 Character Assignment	Readout Instrument UN378593 Character Assignment
1	000000	Space (Clear)	0	Space (Clear)
2	000110	0	24	6
3	011000	I	6	Y
4	100111		57	P
5	011110	V	30	Space (Clear)
6	111111	Space (Clear)	63	Space (Clear)
*7	111011	1	55	Space (Clear)
8	101001	Space (Clear)	37	R
9	000001	Space (Clear)	32	1
10	000100	CR	8	4
11	010010	L	18	S
12	101100	F	13	Space (Clear)
13	010111		58	X
14	111110	—	31	Space (Clear)
15	111011	1	55	Space (Clear)
16	101011	6	53	Space (Clear)
17	001001	Space (Opaque)	36	9
18	000101	cr	40	5
19	010000	LF	2	
20	100110	B	25	0
21	011100	C	14	Space (Clear)
22	110111	—	59	G
23	111010	Q	23	Space (Clear)
24	101011	6	53	Space (Clear)
*25	001011		52	Space (Clear)
26	001101		44	Space (Clear)
27	010001	If	34	Space (Clear)
28	100100	D	9	M
29	010110	G	26	W
30	111100	K	15	Space (Clear)
31	110011	2	51	C
32	101010	Y	21	Space (Clear)
33	001011		52	Space (Clear)
*34	001111		60	Space (Clear)
35	011001	8	38	Z
36	100101		41	N
37	010100	R	10	U
38	110110	Space (Clear)	27	F
39	111000	U	7	H
40	100011	+	49	L
41	001010	H	20	Space (Clear)
42	001111		60	Space (Clear)
*43	011011		54	Space (Clear)
44	101101		45	Space (Clear)
45	010101	4	42	V
46	110100	J	11	D
47	110010	W	19	B
48	101000	S	5	Q
49	000011	5	48	3
50	001110	M	28	Space (Clear)
51	011011		54	Space (Clear)
*52	101111	/	61	Space (Clear)
53	011101	°	46	Space (Clear)
54	110101		43	E
55	110000	A	3	Space (Clear)
56	100010	Z	17	K
57	001000	Space (Opaque)	4	8
58	000111	9	56	7
59	011010	P	22	Space (Clear)
60	101111	/	61	Space (Clear)
*61	011111		62	Space (Clear)
62	111101		47	Space (Clear)
63	110001		35	A
64	100000	E	1	Space (Clear)
65	000010	T	16	2
66	001100	N	12	Space (Clear)
67	010011		50	T
68	101110	X	29	Space (Clear)
69	011111		62	Splice
*70	111111	Space (Clear)	63	Space (Clear)
71	111001	7	39	I
72	100001	3	33	J

*Repeated character. Occurs again eight spaces farther along belt.



SEALED CASE 64-CHARACTER READALL * READOUT INSTRUMENT

The new Sealed Case 64-Character Readall Readout Instrument is a precision-built unit designed to meet the severe environmental requirements specified in MIL-E-5422D and other specifications. It provides reliable operation under conditions of intense shock, vibration and extreme ranges of temperature. The sealed case will protect the instrument in humidities up to 100 percent, and it will operate efficiently at altitudes up to fifty thousand feet. Salt-spray, dust, sand and other foreign particles cannot penetrate the sealed case.

The method of operation for the Sealed Case 64-Character Readall Readout Instrument and the internal arrangement are similar to those of the Standard 64-Character Readall Readout Instrument described on Page 6 of Union Switch & Signal Bulletin 1057. Greater flexibility of operation is provided through the separate code and motor circuits, which permit application in low-level and solid-state circuitry.

This 64-Character Readout Instrument is back-lighted with diffused light by means of two miniature aircraft-type lamps which provide burn-out protection. In event one lamp fails, the second lamp will assure continued readability. However, the black and white character belt is readable with or without internal illumination under normal conditions.

This Sealed Case 64-Character Readall Readout Instrument is 8-17/32 inches long and weighs 14 ounces. This instrument mates with military standard connector MS24013.

Specifications

Character Size (letter M)

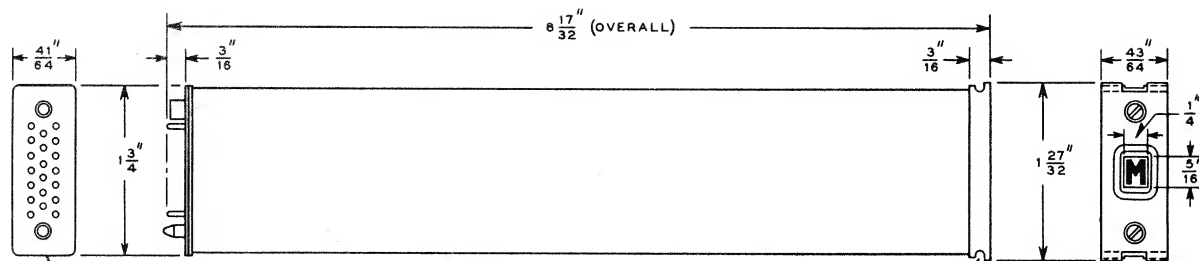
Height	9/32 Inch
Width	13/64 Inch
Character Stroke Width.....	0.032 Inch

Nominal Operating Data

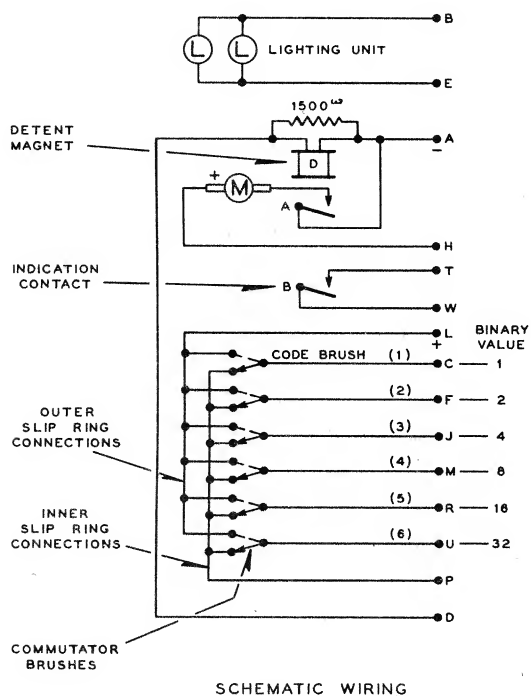
Voltage	24-28 Volts DC
Motor Starting Current at 26 VDC.....	0.500 Ampere
Motor Running Current at 26 VDC.....	0.150 Ampere
Running Time (71 belt spaces)	1.5 Seconds
Service Life	5 x 10 ⁵ Random Indications
Detent Magnet Current at 26 VDC.....	0.150 Ampere
Lamp Voltage	28 Volts
(6V or 14V lamps can be supplied upon request)	

Ordering Reference Readout Instrument UN382750-009

* Trademark



(FOR REF. ONLY)
 MATING RECEPTACLE (20 PINS)
 (MS24013) USAF STOCK NO. UI-20F-25 007-RG
 MUST BE ORDERED SEPARATELY

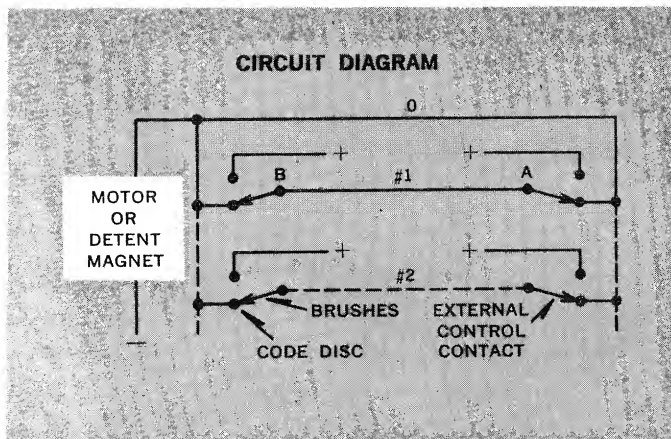


Belt Position	Code 1-2-4-8-16-32	Character Assignment
1	000000	Space (Clear)
2	000110	0
3	011000	I
4	100111	⊕
5	011110	V
6	111111	Space (Clear)
*7	111011	1
8	101001	Space (Clear)
9	000001	Space (Clear)
10	000100	CR
11	010010	L
12	101100	F
13	010111	/
14	111110	—
15	111011	1
16	101011	6
17	001001	Space (Opaque)
18	000101	cr
19	010000	LF
20	100110	B
21	011100	C
22	110111	—
23	111010	Q
24	101011	6
*25	001011	↓
26	001101	⊕
27	010001	If
28	100100	D
29	010110	G
30	111100	K
31	110011	2
32	101010	Y
33	001011	↓
*34	001111	•
35	011001	8
36	100101	/
37	010100	R
38	110110	Space (Clear)
39	111000	U
40	100011	+
41	001010	H
42	001111	•
*43	011011	⊕
44	101101	→
45	010101	4
46	110100	J
47	110010	W
48	101000	S
49	000011	5
50	001110	M
51	011011	⊕
*52	101111	/
53	011101	O
54	110101	/
55	110000	A
56	100010	Z
57	001000	Space (Opaque)
58	000111	9
59	011010	P
60	101111	/
*61	011111	⊕
62	111101	↑
63	110001	↑
64	100000	E
65	000010	T
66	001100	N
67	010011	/
68	101110	X
69	011111	⊕
*70	111111	Space (Clear)
71	111001	7
72	100001	3

*Repeated character. Occurs again eight spaces farther along belt.

Character assignments other than those shown can be provided.

Readall OPERATION and APPLICATION



Basically, the READALL Readout Instrument consists of a miniature motor with suitable gearing to drive a belt or wheel to a number of discrete positions. At each discrete position, a brush assembly contacts a printed circuit code disc to present a binary code to the code wire terminals on the back-plug.

If the internal binary code thus established differs from an externally applied binary code, the mismatch will cause the instrument to operate until the internal code agrees with the external code. When such matching occurs, the drive-motor circuits are deenergized and the belt or wheel is detented at the correct position and the desired character is displayed on the face of the instrument.

Data storage is provided when the belt or wheel is stationary, simply by the inherent position of the brushes on the code discs, which present the binary code to the code wire terminals on the back-plug.

A simplified circuit that illustrates circuit operation is shown in Figure 1. As illustrated, A is a single-pole double-throw contact assembly, or its solid state equivalent, representing external control.

B represents one code disc brush in the Readout Instrument. Brush B is shown in its down position to represent a contact with a segment of the code disc. At certain other positions on the code disc, the brush will make contact with another segment, represented by brush B in its up position.

With both A and B down, as indicated, the circuit is open and the instrument cannot run. If contact A is moved to an up position, the circuit will be energized over wire #1, and will operate the readout instrument until B is also in an up position. If A is then moved down again, the instrument once more will be energized by a current passing through wire #1 in the opposite direction, and the readout instrument will operate until B is in its down position. This may be termed an 'agreement' circuit since the motor always will operate until contacts B agree in position with contacts A.

It will be realized at this point that switch A can have only two positions; hence, a selection of only two characters can be made in the Readout Instrument. If circuit #2 is now added, as indicated by the dotted line, it can be seen that the indicator will operate until both of the contacts at B agree in position with both of the contacts at A.

The positions of the readout brushes are given binary values; '1' when a brush is in the up position, and '0' when in the down position. Agreement, and subsequent readout of the character corresponding to a binary code, is obtained when all the 'ones' and 'zeros' supplied from the code circuits are matched by the readout code disc.

Several models of the READALL Readout Instrument are available with the code disc circuits electrically separated from the detent and/or motor circuits. This separation facilitates the use of the code disc assembly in low current, low voltage, logic circuits utilizing transistors or diodes and permits the motor circuits to be controlled with power transistors or sub-miniature relays.

Block diagrams showing typical systems applications of READALL Readout Instruments are shown on Page 10. Circuit drawings showing transistor and relay circuits are available upon request.

APPLICATION DATA and Mounting Information

In order to assist in the application of READALL Read-out Instruments, additional technical information has been compiled and will be furnished on request, without obligation.

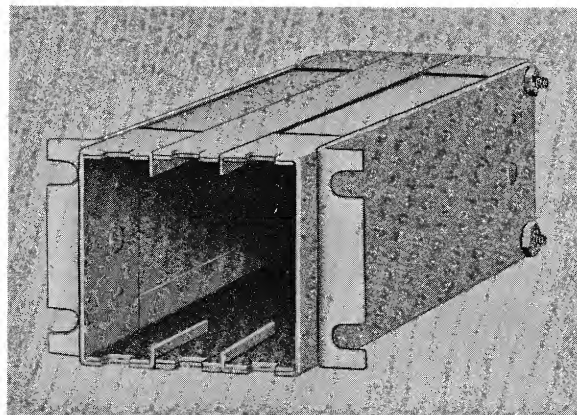
Typical circuits for several code translations, transistor drives, electrical readouts, etc., are available as well as information concerning various methods of mounting READALL Instruments in panels, consoles and instrument cases. The following illustrations suggest several mounting methods.

1. Multi-Unit housing for application to back of panel. Instruments are removed or replaced from the front portion of the panel. A bezel or frame on the front of the panel is required to retain the mounted instruments or to enhance the appearance of the panel. Individual plug-receptacles are permanently mounted in housing.

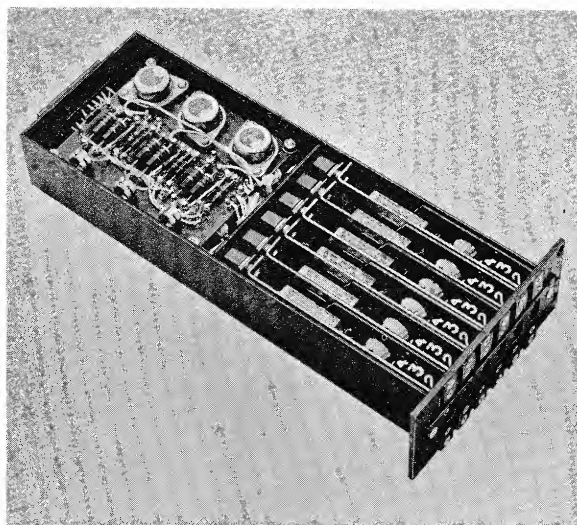
2. Modules without individual cases can be mounted in one multi-unit housing.

3. Honeycomb type of instrument console with receptacles permanently mounted in the back of each containing slot.

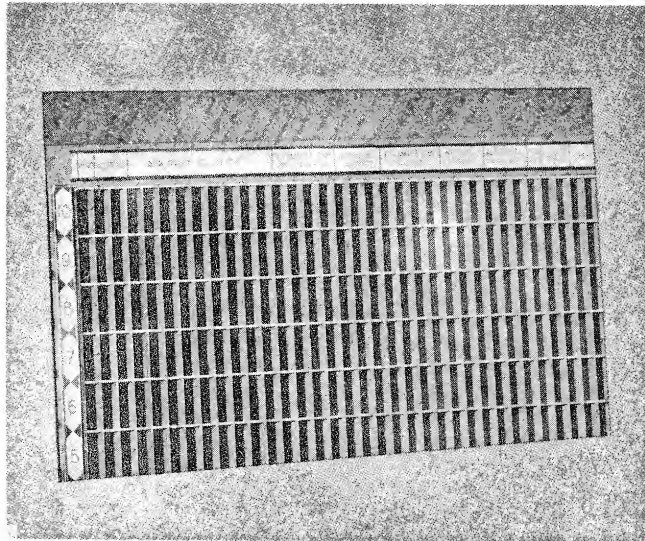
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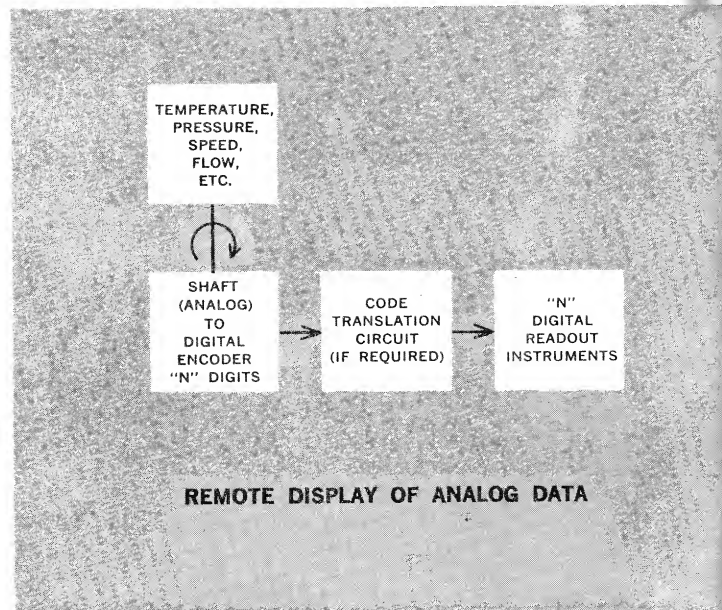
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3



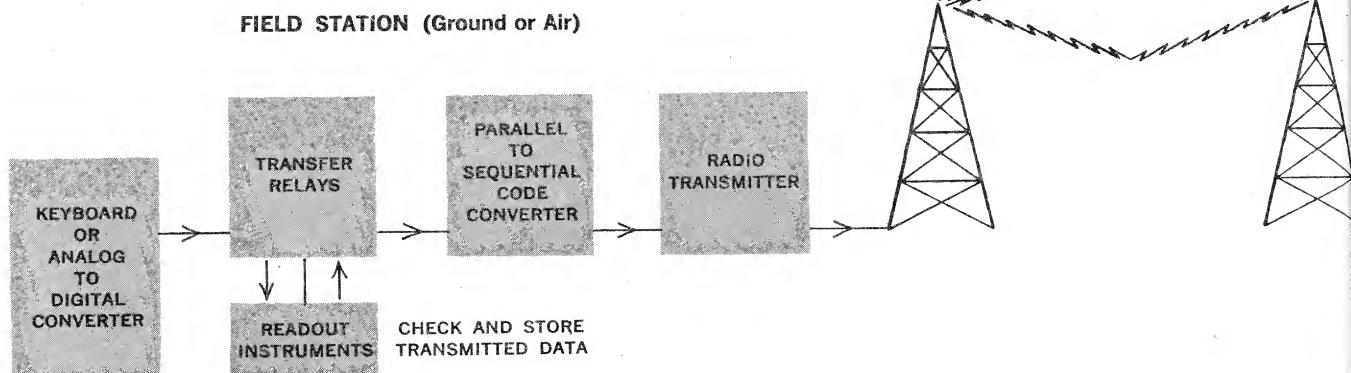
Typical Readall Readout Instrument APPLICATIONS

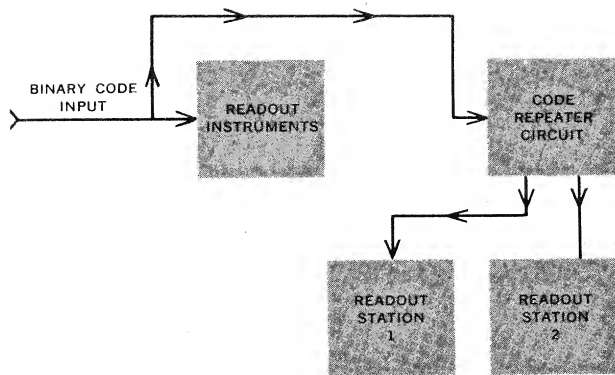


The block diagrams illustrated on these pages represent typical applications of READALL Readout Instruments. Although a limited number of applications are shown, they emphasize the fact that READALL Readout Instruments are designed specifically for use where binary coded information must be displayed, stored and transferred, and suggest methods of simplifying encountered problems.

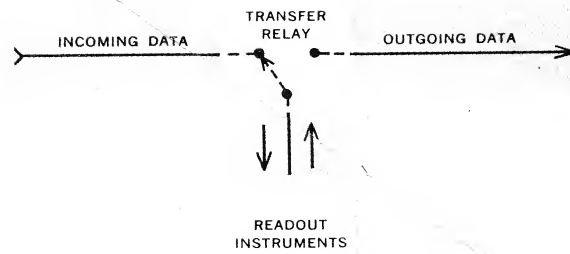
There is a great reduction in the amount of associated equipment required when employing these instruments in any such installation. In addition to economic advantages, the reliability factor makes Union Switch & Signal READ-ALL Readout Instruments ideal for use in numerous applications. Qualified sales personnel are available to assist you in applying READALL Readout Instruments to your data-handling problems.

TYPICAL TELEMETERING SYSTEM

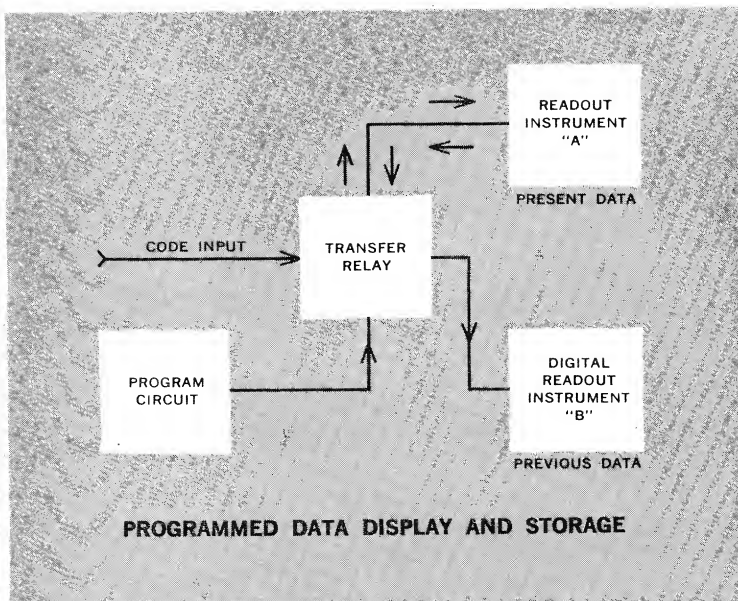




REMOTE DISPLAY OF BINARY CODED DATA

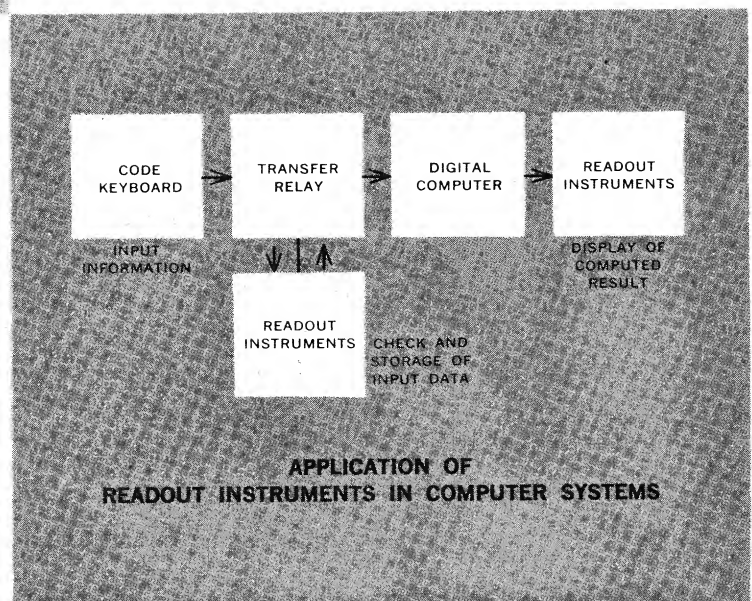
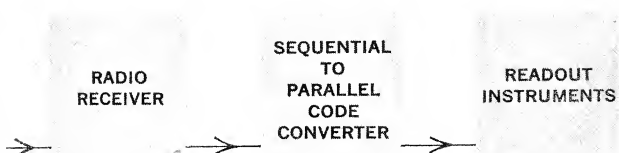


RECEIVING, READING, STORAGE AND TRANSMITTAL OF DATA



PROGRAMMED DATA DISPLAY AND STORAGE

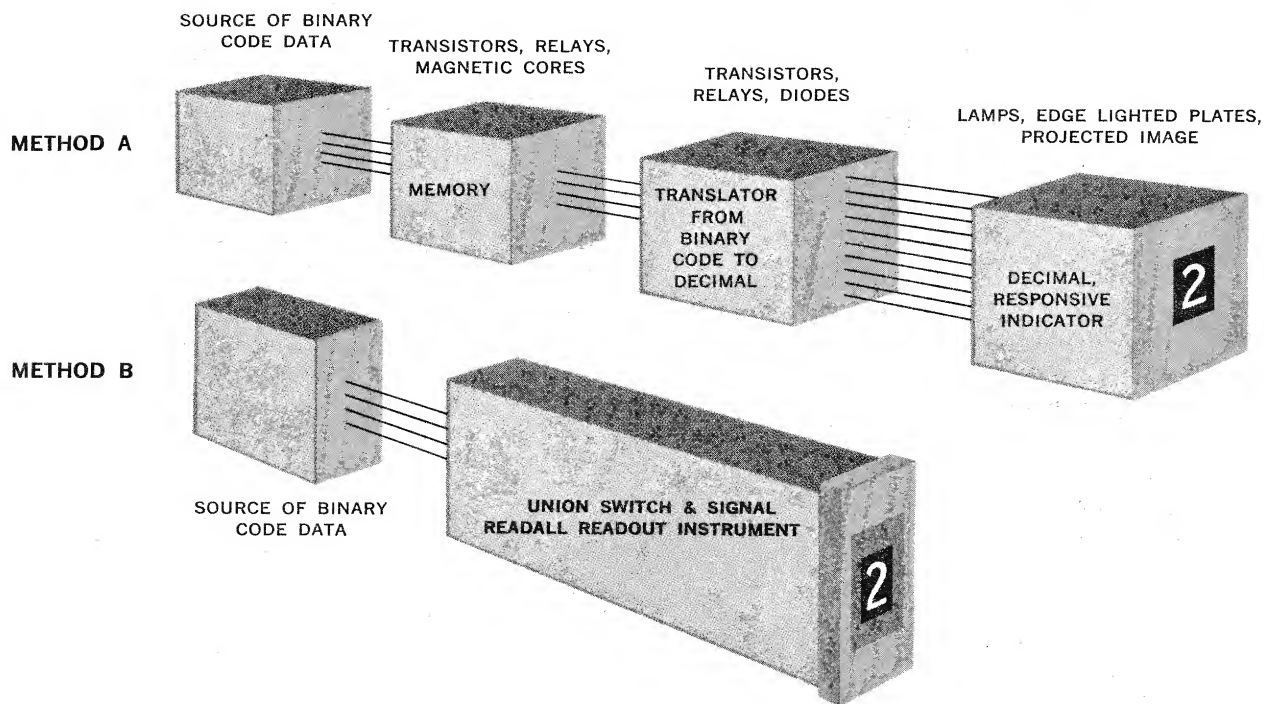
OFFICE STATION



APPLICATION OF READOUT INSTRUMENTS IN COMPUTER SYSTEMS

COMPARE

Union READALL Readout Instruments with ordinary display methods



A comparison of the two methods of displaying information, as shown above, reveals the advantages of employing READALL Readout Instruments in your particular application. Method A shows a system which requires the use of complicated conversion equipment to bring about a visual display of desired data. Method B reveals the reduction in the amount of associated units when READALL Readout Instruments are used. The additional equipment required in Method A increases the initial equipment costs as well as the installation and maintenance costs. Use of READALL Readout Instruments in commercial, industrial and military applications makes it possible to eliminate the 'black boxes' ordinarily required for use with more indirect readout methods.



UNION SWITCH & SIGNAL DIVISION

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